

CLAIMS

1. Capsule filler for packaging bulk substances in hard gelatin capsules, of the type comprising a carousel (1) which rotates about its own vertical axis (101) and carries on it a coaxially positioned hopper (2) into which the product (P) for dosing is placed in the loose state, and a plurality of volumetric dosing devices fed with the product from the periphery of the said hopper and closed at their lower ends by external movable stop means, which are removed and replaced, after the dose has been formed, by corresponding housings (34) each of which houses the base (C2) of a capsule and has its upper aperture placed next to the lower end of a dosing device to receive therefrom the dose of product following the downstroke of the piston of the said dosing device, characterized by the use of volumetric dosing devices having their bodies fixed to the carousel (1) and their dosing chambers (22) constantly engaged, from above, by the corresponding dosing pistons (9, 9') which slide in these chambers with good lateral sealing characteristics, each of said chambers being provided with a lateral aperture (42, 42') connected with a seal to the lowest and peripheral part of the hopper (2) to receive therefrom the product for dosing, and being closed at its lower end by an external stop means (24) which can be movable if necessary, and which is designed to close or open this dosing chamber and which, in the opening stage, does not create cavitation phenomena in the said chamber, in order to avoid the disintegration of the dose of product to be transferred into the base of the capsule.
- 2) Capsule filling machine according to Claim 1, characterized in that the lower closing stop (24) of the dosing chamber of each volumetric dosing device is made in the form of a vertical push rod and is connected to axial movement means which raise it in the closing stage and lower it in the opening stage.
- 3) Capsule filling machine according to Claim 2, characterized in that the push rod stop (24) for closing and opening the lower end of each dosing chamber (22) of the volumetric dosing devices used for dosing compressible powdered or herb-based products is provided at its top with a small head (124) which has a round section and a diameter less than that of the body of the said push rod, and which partially

engages the lower end of the said chamber (22) with a very small clearance of specified extent, through which a small amount of the gas contained in the dose of product can be vented during the compression stage to which the said dose is subjected before the lowering of the stop in question, or through which air can pass during the lowering of the said stop, to prevent cavitation phenomena in the dosing chamber in the stage of opening the lower end and preparation for the transfer of the dose of product into the base of the capsule.

4) Capsule filling machine according to Claim 1, characterized in that the lateral aperture (42, 42') of each dosing chamber (22) of the volumetric dosing devices is located at a small distance from the lower end of the said chamber (22).

5) Capsule filling machine according to Claim 4, characterized in that, for the dosing of compressible powdered or herb-based products, the lateral aperture (42) of the dosing chamber opens towards the flow of product from the feed hopper (2) with a configuration (242) which is diverging and free of dead zones and opens into the said chamber with a downwardly inclined portion (142), such that an angle of less than 90° is formed above with the axis of the said chamber, and the lower edge of this portion reaches the base of the said dosing chamber (22).

6) Capsule filling machine according to Claim 5, characterized in that the downwardly inclined portion (142) of the said lateral aperture (42) of the dosing chamber (22) opens into this chamber with lateral opposing recesses (142) having sharp edges, partly orientated with the appropriate inclination in the longitudinal direction and partly orientated with the appropriate inclination in the transverse direction of the said chamber (22).

7) Capsule filling machine according to Claim 5, characterized in that the pistons (9) of the volumetric dosing devices have sharp cutting lower edges.

8) Capsule filling machine according to Claim 1, characterized in that, for the dosing of very fluid and non-compressible products, such as those based on microgranules or pellets, the volumetric dosing devices with fixed chambers use pistons (9') whose lower ends are porous, axially hollow and connectable at their upper ends, when so commanded, to a source of suction or of delivery of

compressed gas, the dosing chamber (22) of each of the said dosing devices being provided with a lateral aperture (42') for the entry of the product, which is located at a short distance from the lower end of the said chamber and which consists of a small radial hole which opens into the said chamber with a flared edge and which opens
5 towards the product feed flow with a wider flared configuration which is free of dead zones.

9) Capsule filling machine according to Claim 8, characterized in that the push rod stops (24) for closing or opening the lower ends of the dosing chambers (22) of the volumetric dosing devices with fixed chambers are such that they close and seal
10 these chambers when they are in the raised position, each of the said stops being provided for this purpose with an insert (224) made from elastic and yielding material which provides the said condition of sealing when it is in contact with the lower part of the body of the dosing device, on which the said dosing chambers open.

10) Capsule filling machine according to one or more of the preceding claims,
15 characterized in that the volumetric dosing devices with fixed dosing chambers (22) are located outside the product hopper (2), in such a way that they can be rapidly replaced when the format of the capsules for filling is changed.

11) Capsule filling machine according to Claim 10, characterized in that the dosing devices with fixed dosing chambers (22) are located outside the product hopper (2),
20 at an appropriate distance therefrom, are located at a lower height and on the sides of a polygon which is coaxial with and has a greater diameter than the plan view of the said hopper, in such a way as to promote the free and full outflow of the product initially, and then of the washing and sterilization fluids, through the dosing devices, partly by the action of gravity.

25 12) Capsule filling machine according to one or more of the preceding claims, characterized in that the volumetric dosing devices are grouped in sets of two or more in a single body (6), for example in sets of two or three, are equidistant from each other, and having their axes on a theoretical vertical plane which is a tangent to the theoretical circumference of the carousel (1) on whose periphery the dosing

stations with two or more units as stated above are fixed, one after the other and spaced apart at equal intervals.

- 13) Capsule filling machine according to Claim 12, characterized in that each dosing station comprises a body (6) of essentially rectangular plan, fixed to and projecting from the rotation carousel (1) by means of a suitable fixing (206) and provided, on the wall opposite that used for fixing, with an upper projecting portion (106) through which pass two or more identical vertical holes (7) in which the bodies (109) of the corresponding pistons (9, 9') of the volumetric dosing devices are mounted so that they are slidable in the axial direction, with the interposition of low-friction bushes (8), these pistons moving out of the lower ends of the said holes (7) and sliding axially with a lateral seal into the corresponding volumetric dosing chambers (22) formed in a bracket (19) which is fixed under the said piston guide part (106) and on whose end wall for contact with the said body (6) there open lateral apertures (42, 42') of the said dosing chambers, which are connected through seals (44) to corresponding channels (43) which are formed in the said body (6) with a correct convergence towards the axis of the carousel and which open on the upper part of this body, where composite ducts (45) are inserted into these channels with a lateral seal, these ducts having their other ends connected with a lateral seal to corresponding perimetric holes of the base area of the product feed hopper (2).
- 14) Capsule filling machine according to Claim 13, characterized in that the bracket (19) with the dosing chambers (22) contains, in the most projecting part and in a quantity of one for each dosing device, the vertical housings (23) for opening and closing gelatin capsules (C), the said bracket being provided with means (20, 21) for removable and simplified fixing to the body (6), in such a way that it can be replaced rapidly when the format of the capsules for filling is changed.
- 15) Capsule filling machine according to Claim 13, characterized in that the pistons (9, 9') of the volumetric dosing devices with fixed chambers are fixed at their upper ends, with the interposition of removable and simplified fixing means (10-12) which enable them to be replaced rapidly when the format of the capsules to be filled is changed, to a link (13) whose ends are, in turn, fixed to a pair of vertical rods (15)

which extend downwards, are located laterally with respect to the fixed body (6) of each dosing station, are guided into the carousel (1) of the machine and have their lower ends fixed to a traveller (16) whose roller (116) follows the double-acting profile of an annular cam (17) mounted coaxially on the fixed base column (B) of the machine.

16) Capsule filling machine according to Claim 15, characterized in that the annular cam (17) for driving the pistons (9, 9') of the volumetric dosing devices with fixed chambers is of the type which comprises remotely controllable means (117) for modifying the inclination, from zero to a specified maximum number of degrees, of the ramps which transmit the axial dosing and compression movement to the said pistons, and consequently to vary the stroke of the said pistons from zero to the desired value.

17) Capsule filling machine according to Claim 15, characterized in that the annular cam (17) for driving the pistons (9, 9') of the volumetric dosing devices with fixed chambers is mounted on the base column (B) with the interposition of a vertical slider controlled by a servo controller (18) with a remotely controllable motor, so that the said cam can, when so commanded, be moved from a low position, in which the said pistons are in the operating position within the corresponding dosing chambers (22), to a raised position in which the said pistons are raised above the said dosing chambers, to prepare them for replacement or to prepare the whole assembly for the machine washing and sterilization cycle.

18) Capsule filling machine according to one or more of the preceding claims, characterized in that the push rod stops (24) of each dosing station are mounted on a cross piece (25) provided with means (26, 27) for removable and simplified fixing to a cross piece (28) whose ends are integral with the upper ends of a pair of vertical rods (29) which extend downwards, are guided into the carousel (1), and have their lower ends integral with a traveller (30) whose roller follows the double-acting profile of an annular cam (32) fixed on the axial base column (B) of the machine.

19) Capsule filling machine according to one or more of the preceding claims, characterized in that a pair of horizontal rods (38) is fixed under the bracket (19)

containing the dosing chambers (22) of the volumetric dosing devices, in the space between the push rods of each dosing station, these horizontal rods being guided through the fixed body (6) of each station and being guided into the carousel (1) where they are fixed to a traveller (39) whose roller (40) follows the double-acting profile of a disc cam (41) fixed on the axial base column (B) of the machine, the outer ends of the said rods being integral with a cross piece (37) on which can be fixed in a rapid and removable way a parallelepipedal block (33) having vertical housings (34) whose diameters decrease towards their lower ends and which are movable horizontally, and can be aligned axially, by the movement imparted by the said cam, with the vertical outer housings (23) of the said bracket (19) located above them, to receive from the latter housings the bases (C2) of the capsules which are to be transferred for filling to positions under the dosing chambers (22) and which are then to be returned to a position of alignment with the said housings (23) for reconnection to, and closing with, the covers (C1) of the said capsules.

20) Capsule filling machine according to one or more of the preceding claims, characterized in that the vertical and axially hollow push rods (76), which are vertically movable and pass through the said horizontally movable housings (34) from below, and which initially hold by suction the bases of the empty capsules from the housings (23) of the fixed bracket (19) located above them, and then move downwards to transfer the said bases into the underlying horizontally movable housings, while the covers (C1) of the capsules remain in the housings (23) located above, and which then, when the bases (C2) are full, rise, with the use of suction if necessary, to raise the bases (C2) and close them with the corresponding covers (C1) located above them, these covers being temporarily retained by suitable upper stop means which are subsequently inactivated to allow the full and closed capsule to be raised and expelled by suitable means for collection (86) and removal at the correct time, are fixed to a common cross piece (77) provided with means (78, 79) for removable and simplified fixing to a corresponding cross piece (80) whose upper end is integral with a pair of vertical rods (81) which extend downwards, which are guided into the carousel (1) and which have their lower ends integral with a traveller (82)

whose roller (83) follows the double-acting profile of an annular cam (84) which is fixed to the axial base column (B) of the machine and which is of the type whose working profile can be modified by remote control by means of servo controllers (184) driven by an electric motor with electronic speed and phase control, to enable the
5 length of travel of the said push rods to be modified in accordance with the format of the capsules to be filled.

21) Capsule filling machine according to one or more of the preceding claims, characterized in that an annular fixed trough (1000) is provided under the dosing stations and under the lowest and widest part of the carousel (1) which carries these
10 stations and the corresponding lower moving auxiliary parts (24, 33, 76), this trough collecting and guiding towards an outlet all the washing and sterilization liquids used for cleaning the internal and external parts of the machine, to prepare it from time to time for packaging different products.

22) Capsule filling machine according to one or more of the preceding claims,
15 characterized in that an annular basket (4) is provided coaxially with and outside the hopper (2) containing the product to be dosed and inserted into the capsules, and is supported by the said hopper by means of supports (3), means (5) being provided in a higher position for feeding the empty capsules (C) into this basket, and an aperture being provided in the base of the said basket at the position of each dosing station,
20 each of these apertures having a set of vertical tubes (50) passing through it, these tubes being subjected to an alternating vertical movement so that each of the said tubes, which has a funnel-shaped and externally rounded upper inlet, is filled with a line of empty capsules, with their bases orientated upwards or downwards in a random way, the lines of capsules being retained in these tubes by the bent teeth of
25 a comb (59) oscillating on a transverse pivot (60), held in the closed position by elastic means (61) and provided, on the opposite side to that facing the carousel, with a horizontal roller (62) which, when the set of tubes in question is lowered, interacts with a stop track (85) which is fixed to the base of the machine and which opens the said comb to allow the capsules to drop from the tubes, the said set of
30 tubes (50) being provided with means (51, 52) for rapid and removable fixing to a

cross piece (53) integral with the upper ends of a pair of vertical rods (54) which extend downwards and laterally with respect to the fixed body (6) of the volumetric dosing station, which are guided into the carousel (1), and which have their lower ends integral with a traveller (55) whose roller (56) follows the double-acting profile of an annular cam (57) fixed on the base column (B) of the machine.

23) Capsule filling machine according to Claim 22, characterized in that there are provided, in the spaces between the guide housings for the bodies (109) of the dosing pistons formed in the fixed body (6) of each volumetric dosing station, two horizontal guide housings through which pass a pair of rods (68) which also pass slidably through the carousel (1) and which are integral within the carousel with a traveller (69) whose roller (169) follows the double-acting profile of a disc cam (70) fixed on the axial base column (B) of the machine, the outer ends of the said horizontal rods (68) being integral with a cross piece (67) on which can be fixed, by removable and simplified fixing means (65, 66), the set of vertical wells of a known type (64) which are open longitudinally on the side opposite that facing the carousel, and each of which has a lower portion in which the capsule can slide freely and an upper portion with a diameter which interacts with friction with the cover of the capsule, and has, on the side facing the carousel, small holes in its lower and intermediate parts, which, when the wells approach the carousel, are passed through by horizontal points of different lengths and of known types (71, 72), the lower of these points retaining in the upper part of the well the capsule fed from the tube (50) located above, while the upper point orientates the capsule horizontally and always with the base pointing outwards, these points being integral with the carousel.

24) Capsule filling machine according to Claim 23, characterized in that the points (71, 72) for retaining and pre-orientating the empty capsules in the set of vertical and horizontally movable wells (64) are fixed on a block (73) which is mounted with removable and simplified fixing means (74, 75) on the upper projecting part (106) of the fixed body (6) of each volumetric dosing station.

25) Capsule filling machine according to the preceding claims, characterized in that the set of vertical tubes (50) carries flat downwardly orientated pushers (63),

terminating in tapered lower portions having a length suitably greater than that of the capsules, and having a rounded lower point (63') and an upper step (63'') on the side facing the set of vertical wells (64) with which the pushers in question interact to push downwards the capsules which have been pre-orientated by the upper points (71), to

5 make the said capsules move into the lower and wider portions of the said wells, still with their bases orientated downwards, means being provided to ensure that the said push rods are positioned, at the end of their downward travel, with their lower points on the housings (23) which contain the covers (C1) of the underlying full bases (C2) of the capsules to be closed, to act as stops during the closing of the said capsules.

10 26) Capsule filling machine according to one or more of the preceding claims, characterized in that it comprises means for enabling the following operational stages to be carried out in succession: the lowering of the set of vertical tubes (50), the opening of the lower end of each tube and the placing of its lowest capsule on the upper edge of a vertical well (64) while the capsule contained in this well and

15 previously pre-orientated horizontally is pushed into the lower part of the said well by a pusher (63) associated with the set of vertical tubes (50), the lower point of each pusher acting as a stop for the stage of closing the bases of the capsules filled with product; the horizontal movement of the set of wells (64) towards the carousel and the alignment of the wells with the tubes (50) positioned above them, and the entry of

20 the intermediate horizontal point (72) into each well to arrest the capsule falling from the said tubes; the raising and simultaneous closing of the lower end of the set of tubes (50) while the set of wells (64) is moved horizontally towards the carousel for the horizontal pre-orientation by the upper points (71) of the capsules previously fed into the wells; the horizontal movement of the set of wells (64) away from the

25 carousel, to disengage the horizontal arresting and pre-orientating points (72, 71) and to align the said wells with the underlying housings (23) of the bracket (19) associated with the dosing devices, in order to transfer into these housings the underlying empty capsules; and the return of the set of wells towards the carousel if necessary, to repeat the stage of horizontal pre-orientation of the upper empty

30 capsules, and the horizontal movement of the said set of wells (64) away from the

carousel to realign them with the pushers (63) of the set of vertical tubes (59) located above them, which in the next stage is moved downwards so that the said pushers orientate the capsules with their bases downwards and push them into the lower parts of the said wells, thus preparing the whole machine for the repetition of the cycle which has been described.

27) Capsule filling machine according to the preceding claims, characterized in that it comprises means for enabling the following operating stages to be carried out in succession: the raising of the vertical push rods (76) through the vertical and horizontally movable housings (34) under the dosing stations; the insertion of these push rods into the corresponding vertical housings (23) of the brackets (19) of the said dosing stations, into each of which the set of wells (64) feeds an empty capsule; the gripping of the lower bases of these capsules by suction and the lowering of the said push rods until they emerge from the said horizontally movable housings (34) in such a way that the bases of the empty capsules (C2) are transferred into these housings while their covers (C1) remain in the upper fixed housings (23); the transfer of the horizontally movable housings (34) with the empty bases of the capsule towards the station for filling with the doses of product; the raising of the push rods (76) into the upper fixed housings (23) which contain the covers of the capsules, with a travel which does not move the said covers but which is capable of expelling any capsule not opened in the preceding stage, the push rods being subsequently made to move downwards again to the lower rest position; when the horizontally movable housings (34) containing the bases of the capsules filled with product are realigned with the fixed seats (23), located above them, of the bracket (19) associated with the dosing devices, the push rods (76) are raised to raise the full bases (C2) and to reconnect them to, and close them with, the corresponding covers (C1) located in the upper housings and retained there by the lower points (63') of the said pushers (63) for orientating the empty capsules, which are then raised to allow the push rods (76) to be additionally raised to cause the filled and closed capsules to emerge from the upper parts of the said fixed housings (23), suction being provided through the push rods (76) if necessary in this stage, in order to retain the capsules correctly while they

are collected at the correct time by means of removal (86); the lowering of the push rods from the upper fixed housings (23) and the simultaneous cleaning of these with a jet of compressed air; and the raising of the push rods (76) and the provision of suction through them for gripping the next empty capsules and for the repetition of the cycle which has been described.

28) Capsule filling machine according to one or more of the preceding claims, characterized in that it comprises means (91, 191) for internally pressurizing the hopper (2) for feeding the product to be dosed, particularly if the product is powdered or herb-based and compressible, with gas which is preferably inert, at specified pressure levels, in such a way that the product contained in the hopper is fluidized and is pushed by the said gas pressure towards the volumetric dosing stations.

29) Capsule filling machine according to Claim 28, characterized in that the product hopper (2), which rotates about its own axis, is provided axially with an upper aperture which is connected by means of a rotary joint (88) to the flange (189) of a compensation chamber for the cyclical feeding of batches of product, this chamber being fixed to a fixed supporting frame (90) and being intercepted at its lower end by a normally closed valve (93), a duct (91) for the internal pressurization of the hopper being connected to the said flange (189).

30) Capsule filling machine according to Claim 28, characterized in that it comprises mechanical means for fluidizing the product within the hopper (2) and if necessary also in the ducts (45, 43) which feed the said product to the volumetric dosing stations.

31) Capsule filling machine according to Claim 30, characterized in that the product hopper (2) is round in plan view and is formed by a lower bowl (102) with its base (102') raised towards the centre and closed by a cover (202) of conical and upwardly converging shape, in such a way as to promote the flow of the product towards the perimeter of the base bowl of the said hopper, where there are perimetrically positioned outlet apertures (47) which feed the product to the dosing stations of the machine, this shape of the hopper being additionally useful for

ensuring thorough and uniform internal cleaning of this component during the cyclical washing and sterilization stages.

32) Capsule filling machine according to Claim 31, characterized in that the base (102') of the hopper (2) is provided axially with an aperture through which a shaft (87) passes rotatably and with a lateral seal, the end of the shaft inside the hopper carrying blades (187) which slowly remix and fluidize the product placed in the said hopper, the said shaft being driven by suitable means (287, 387) with a slow rotary movement relative to the said hopper.

33) Capsule filling machine according to Claim 32, characterized in that the shaft (87) which carries the blades (187) for fluidizing the product within the hopper (2) can be axially hollow and can be used to send compressed gas into the said hopper, as an alternative to or in combination with the aforesaid means (91).

34) Capsule filling machine according to one or more of the preceding claims, characterized in that it comprises a limited number of volumetric dosing stations of the aforesaid type, which, with their corresponding service equipment, included the hopper (2) with the corresponding pressurized product feed parts, are mounted on a fixed frame, while the various movements of the means of dosing the product and moving the capsules are obtained by making the cams (84, 17, 32, 57, 41 and 70) rotate, or by replacing them with programmable actuators, driven for example by electric motors with electronic speed and phase control.